Design and Development of Control and Instrumentation system for aerospace class autoclave

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Autoclave has enabled the replacement of metallic aerospace structures by advanced composites structures. It is a batch process control system that provides controlled temperature, pressure and vacuum environment for accurate and consistent processing of polymeric composites. Extensive use of composites in Boeing 787 Dreamliner aircraft is a testimony to the advancements in polymeric composites and their reliable processing in autoclaves.

Advanced composite materials are very expensive and often require many man months of preparatory work before they are loaded into autoclave for processing also known as curing. The polymer cure process is irreversible and deviation in process parameters beyond the narrow tolerance levels would result in the rejection of composites. Hence the autoclave in general and Control and Instrumentation system in particular should have adequate redundancy, fail-safe design, fault tolerance and high reliability.

This paper presents the conceptualization, design, development, integration and commissioning of open architecture, multimode autoclave C&I system including the associated electrical and software systems.

Few selected slides presented during the lecture are given below:

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D&D of C&I system for aerospace class autoclave

CSIR

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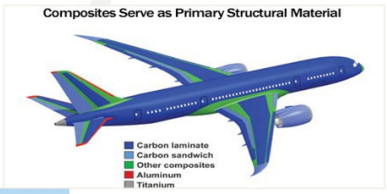
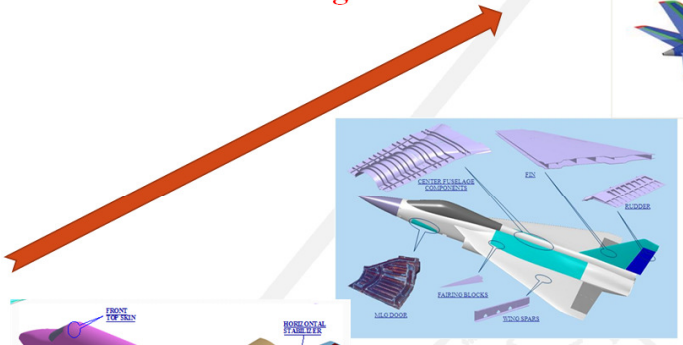
Outline

- Introduction to autoclave and its C&I system
- Design Drivers & Challenges
- Architecture
- State of the art features
- Job temperature control alogrithm
- NALAS – NAL's Autoclave Software
- Typical autoclave performance
- Conclusion

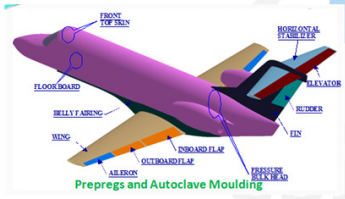
Increasing use of composites

Boeing 787 : ~ 50%





LCA : ~ 45%



SARAS : ~ 30% Airframe by weight is composites

Upgrade of vertical autoclave at VSSC

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Labscale Autoclave for Edu. Ins.

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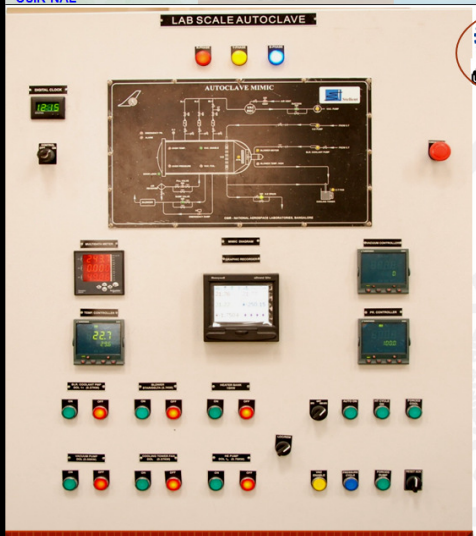
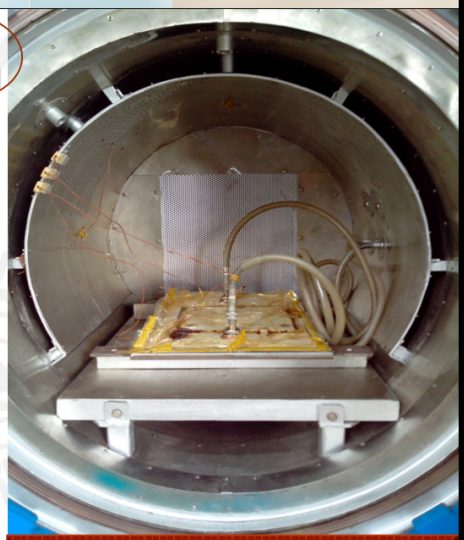
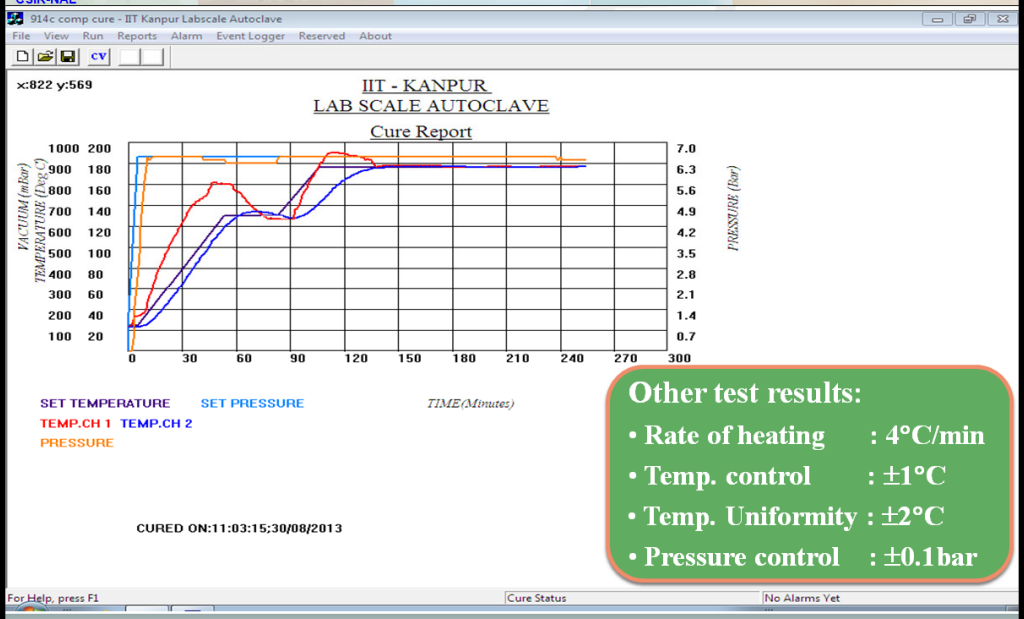


Electrical, Control & Instrumentation Panel



Laminate cured in IIT-K Autoclave

Performance of LS acl



Other test results:

- Rate of heating : 4°C/min
- Temp. control : ±1°C
- Temp. Uniformity : ±2°C
- Pressure control : ±0.1bar

Conclusions

- NAL Autoclaves meet the stringent Process control required for adv. composites processing
- NAL has home grown several innovative solutions and provides world class autoclaves at lower cost through the PPP arrangement.
- The process of capturing requirements, conceiving the architecture, system design, handling multi-disciplinary systems, product development and marketing through PPP were presented for autoclave.